

CLAIMS

1 1 A method for combining a first audio signal from a first audio channel and a
2 second audio signal from a second audio channel, said first and second audio signals
3 having a first and second frequency range, comprising:
4 shifting the phase of said first audio signal relative to said second audio signal,
5 wherein said shifting is substantially limited to a first frequency range; and
6 combining the audio signal from said first channel with the audio signal from said
7 second channel.

1 2. A method for combining audio signals in accordance with claim 1, wherein
2 said first frequency range is the bass frequency range.

1 3. A method for combining audio signals in accordance with claim 2., further
2 comprising downmixing a third channel and a fourth channel to produce a one of said
3 first channel or said second channel.

1 4. A method for combining audio signals in accordance with claim 3, further
2 comprising the step of downmixing a fifth channel and a sixth channel to produce the
3 other of said first channel or said second channel.

1 5. A method for combining audio signals in accordance with claim 1, further
2 comprising downmixing a third channel and a fourth channel to produce a one of said
3 first channel or said second channel.

1 6. A method for combining audio signals in accordance with claim 5, further
2 comprising the step of downmixing a fifth channel and a sixth channel to produce the
3 other of said first channel or said second channel.

1 7. A method for combining audio signals in accordance with claim 1, wherein
2 said relative shifting involves applying said first audio signal to a circuit including a first
3 all-pass filter, filtering said audio signal from said first audio channel, and applying said
4 second audio signal to a circuit including a second all-pass filter, filtering said second
5 audio signal from said second audio channel, wherein parameters of said first all-pass

6 filter and parameters of said second all-pass filter are selected so that said relative shifting
7 occurs only over said first frequency range.

1 8. A method for combining audio signals in accordance with claim 1, further
2 comprising adjusting the frequency response of the path carrying the combined audio
3 signals.

1 9. A method for combining audio signals in accordance with claim 8, wherein
2 said adjusting includes equalizing said combined audio signal.

3
1 10. A method for combining audio signals in accordance with claim 1, wherein
2 said combining combines only the spectral components in said first frequency range.

1 ~~11.~~ An audio system comprising:
2 an audio signal source constructed and arranged to provide a first channel signal
3 and a second channel signal; and
4 a phase shifter, coupled to said audio signal source for shifting, only over a first
5 range of frequencies, the phase of said first channel signal relative to said second channel
6 signal, wherein said phase shifter is constructed and arranged to substantially limit said
7 phase shifting to said first range of frequencies.

1 12. An audio system in accordance with claim 11, is constructed and arranged to
2 maintain the phase of said first channel signal relative to said second channel signal
3 unchanged over a second range of frequencies.

1 13. An audio system in accordance with claim 12, wherein said first range of
2 frequencies is lower than said second range of frequencies.

1 ~~14.~~ An audio system, comprising:
2 a first audio channel input for providing a first audio signal;
3 a second audio channel input for providing a second audio signal;
4 phase shifting circuitry, coupled to said first audio channel input and said second
5 audio channel input, for shifting the phase of said first audio signal relative to said second
6 audio signal over a first range of frequencies to produce a partially phase shifted audio
7 signal; and

8 a combiner, for combining said partially phase shifted first audio signal and said
9 second audio signal to produce a combined audio signal.

1 15. An audio system in accordance with claim 14, said phase shifting circuitry
2 includes a first all-pass filter coupling said first audio channel input and said combiner,

3 said first all pass filter having first filter parameters, and

4 a second all pass filter coupling said second audio channel input and said
5 combiner,

6 said second all pass filter having second filter parameters.

1 16. An audio system in accordance with claim 15, wherein said first filter
2 parameters and said second filter parameters are predetermined so that said phase shifting
3 circuitry shifts the phase of said first audio signal relative to said second audio signal
4 only over said first range of frequencies.

1 17. An audio system in accordance with claim 16, wherein said first range of
2 frequencies is limited to the bass frequency band.

1 18. An audio system in accordance with claim 15, further comprising a third all-
2 pass filter coupling said first all-pass filter and said combiner,

3 said third all-pass filter having third filter parameters

4 and a fourth all-pass filter coupling said first all-pass filter and said combiner,

5 said fourth all-pass filter having fourth filter parameters,

6 wherein said first and third all-pass filters have a frequency spacing of
7 approximately 16 and wherein said second and fourth all-pass filters have a spacing of
8 approximately 16.

1 19. An audio system in accordance with claim 15, further comprising a third all-
2 pass filter coupling said first all pass filter and said combiner,
3 said third all-pass filter having third filter parameters,
4 and a fourth all-pass filter coupling said first all-pass filter and said combiner,
5 said fourth all-pass filter having fourth filter parameters,
6 wherein the combination of said first and third all-pass filters have a frequency
7 spacing factor relative to the combination of said second and fourth all-pass filters of
8 between three and five.

1 20. An audio system in accordance with claim 14, further comprising a first low-
2 pass filter for filtering said first audio signal low-ass filter for filtering said second audio
3 signal so that said combiner combines only the bass portions of said first audio signal and
4 said second audio signal.

1 21. An audio system in accordance with claim 14, further comprising a low-pass
2 filter for filtering the output signal of said combiner to provide only the bass portion of
3 said combined signal.

1 22. An audio system in accordance with claim 14, further comprising a
2 downmixing circuit for downmixing signals in a third channel and a fourth channel to
3 form said first audio signal.

1 23. An audio system in accordance with claim 14, wherein said combiner
2 combines said partially phase-shifted first audio signal and said second audio signal only
3 in said first range of frequencies.

1 ~~24.~~ A method for combining n audio signals from n audio signal channels, where
2 n is a number greater than two, comprising:

3 relatively shifting the phase of each of said audio signals relative to each of the
4 other audio signals to furnish corresponding phase-shifted signals; and
5 combining the n phase-shifted audio signals.

1 25. A method for combining n audio signals in accordance with claim 24,
2 wherein said relative shifting comprises shifting the phase of each of said audio signals
3 by a different amount.

1 26. A method for combining n audio signals in accordance with claim 25,
2 wherein said relative shifting comprises shifting the phase of each of said audio signals
3 by $i \frac{360}{n}$ degrees, where i is an integer index from the group consisting of zero to $n-1$ and
4 one to n .

1 27. A method for combining n audio signals from n audio channels in accordance
2 with claim 24, wherein said shifting is substantially limited to a frequency range.

1 28. A method for combining n audio signals from n audio channels in accordance
2 with claim 27, wherein said frequency range is the bass frequency range.

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